Western Asia, presented by Mr. B. T. Ffinch; two Double-banded Sand-Grouse (*Pterocles bicinctus*) from Senegal, a Lesser Pin-tailed Sand-Grouse (*Pterocles exustus*) from North Africa, presented by Mr. W. H. St. Quintin; a King Parrakeet (*Aprosmictus cyanopygius*) from Australia, presented by Mr. C. D. Chambers; a Delalande's Gecko (*Tarentola delalandii*) from West Africa, presented by Miss Shenton; a Rhesus Monkey (*Macacus rhesus*, ♂) from India, a Great Kangaroo (*Macropus giganteus*, ♂) from Australia, a Salvadori's Cassowary (*Casuarius salvadorii*), a Blue-necked Cassowary (*Casuarius intensus*) from New Guinea, a Beccari's Cassowary (*Casuarius beccarii*) from South-eastern New Guinea, five Oblong Chelodines (*Chelodina oblonga*) from Australia, a Derbian Sternothere (*Sternothaerus derbianus*) from West Africa, a Blackish Sternothere (*Sternothaerus nigricans*) from Madagascar, two Black-necked Swans (*Cygnus nigricollis*) from Antarctic America, deposited.

OUR ASTRONOMICAL COLUMN.

COMET 1899 *a* (SWIFT).—This comet having now passed considerably to the west of the sun, it is possible that it may be observed in the eastern sky before sunrise. The following ephemeris is given by Herr H. Kreutz in *Astr. Nach.* (Bd. 149, No. 3556):—

Ephemeris for 12*h*. *Berlin Mean Time.*

1899.	R.A.	Decl.	Br.
	h. m. s.	° ′	
May 4	23 57 45	+25 17·9	1·74
5	53 54	26 17·3	1·69
6	49 53	27 19·3	
7	45 41	28 24·0	1·67
8	41 17	29 31·5	
9	36 40	30 42·0	1·66
10	31 45	31 55·7	
11	26 28	+33 12·7	1·66

During the week it moves in a north-westerly direction from between Ψ Pegasi and α Andromeda, and is now rapidly decreasing in brightness as it recedes from the sun.

TEMPEL'S COMET (1873 II.).—The following ephemeris is given by M. L. Schulhof in *Ast. Nach.* (Bd. 149, No. 3554):—

Ephemeris for 12*h*. *Paris Mean Time.*

1899.	R.A.	Decl.	Br.
	h. m. s.	° ′ ″	
May 4	18 48 57·0	− 4 42 8	0·460
5	50 39·5	4 37 57	
6	52 21·5	4 33 51	
7	54 3·2	4 29 51	
8	55 44·5	4 25 58	0·521
9	57 25·5	4 22 13	
10	18 59 6·0	4 18 33	
11	19 0 46·1	− 4 15 3	

During the week the comet moves slowly north-eastwards through the northern portions of Scutum Sobieski, and should be looked for in the early morning.

SECOND WASHINGTON STAR CATALOGUE.—Appendix I. to the Washington Observations of 1892 has recently been issued, and is devoted to the publication of the catalogue of standard stars which has been compiled from the work done with the transit circle of the U.S. Naval Observatory during the last thirty years. The instrument was made by Pistor and Martins, of Berlin, and was used almost continually from January 1866 to June 1891, being successively under the charge of Profs. Newcomb, Hall, Harkness, and Eastman. Prof. J. R. Eastman, who had the direction of it from 1874 to 1891, has had almost entire charge of the catalogue, and it is therefore issued in his name. Of the 72,914 observations embodied in the book, 17,334 were made by him personally and 39,867 under his immediate supervision.

The first half of the volume is occupied by descriptions of the apparatus and methods of reduction of the observations. Next come the tables of annual results; then a catalogue of stars employed in the American Ephemeris. The general catalogue, with which the book concludes, gives data for 5151 stars, all for the epoch 1875·0.

SPECTRA OF STARS OF CLASS III. *b*.—Prof. W. C. Dunér, of the Upsala Observatory, has been revising his survey of the red stars by means of the new Steinheil refractor, erected there in 1893. This has a visual objective of 36 cm. aperture, and a photographic objective of 33 cm. aperture. All the spectroscopic observations have been made with ocular spectroscopes of the Zöllner type, with dispersions varying from 3°·5 to 10° from C to G (*Astrophysical Journal*, vol. ix. p. 119, 1899).

In most cases, the previous results were confirmed, but in several of the brighter stars of this class he has found additional features. In all the brighter stars the band 5 (λ 576) is seen to be double, while near to the less refrangible edge of band 6 (λ 5636) a bright band is seen. Additional confirmation of the reality of these details is provided by the photograph of the spectrum of 132 Schjellerup in the *Astrophysical Journal*, vol. viii., which clearly shows a bright line at λ 5595. Variations in the relative intensities of the bands are common, notably in the case of bands 6 (λ 5636) and 4 (λ 586). In 152 Schj., the brightest of this class of stars, band 6 and 9 are very bright, while band 4 is quite faint. In 280 Schj. band 4 is the strongest in the spectrum, while band 6 is scarcely visible. Prof. Dunér thinks that, by a closer attention to these variations, a classification of these red stars would be rendered possible.

LEAD COMPOUNDS IN POTTERY GLAZES.[1]

IT has been known for some months that Prof. T. E. Thorpe, F.R.S., and Prof. T. Oliver, had been commissioned by the Home Secretary to investigate the use of lead compounds in the production of pottery glazes and colours, and to suggest means which might be adopted to counteract the evils admitted, on all hands, to follow from their use. It had been found considerably easier by those who had drawn public attention to these evils even to exaggerate them, grave as they were, than to devise remedies which had any chance of practical adoption at the hands of the trade. The scientific eminence of Profs. Thorpe and Oliver, and their practical acquaintance with the details of many manufacturing processes, warranted the opinion that the choice of the Home Office was a wise one. The appearance of their report marks a very welcome stage in the treatment of this troublesome and intricate question. There exists in this country a pottery industry of considerable dimensions, producing pottery wares of infinite variety, and supplying, not merely the demands of our own country, but possessing, probably, a larger export trade than that of any similar industry in the world. This industry has been built up on the practical experience of generations of workers in the same business. The methods in use may appear, in many cases, to be the reverse of scientific; but, at all events, they have sufficed for the production of pottery of excellent make and finish, at a price which enables our potters still to hold their own, in spite of the efforts of their foreign rivals to copy their methods, their shapes, and their designs. It is idle for any one to deny the fact that, for pottery such as forms the bulk of our productions, glazes containing lead compounds are the simplest and the most trustworthy, and best fulfil all the requirements of a difficult and complicated manufacture. It is admitted, however, that lead compounds, used in the form and proportions common in English practice, may, and often do, cause serious illness and suffering—amounting in extreme cases to blindness, paralysis, and death—to those employed in certain of the processes of pottery production. Regulations have been framed from time to time by the Home Office, designed to minimise these evils. The latest proposals of this kind, which came into force only at the end of last year, deal with the removal of dust from work-rooms; the provision of means by which dust containing lead compounds shall be kept from the face of the worker; the provision of overalls and head coverings, as well as adequate and convenient washing accommodation for all workers who come in contact with lead compounds; and last, but by no means least, provide for a compulsory monthly medical examination of all women and young persons employed in certain specified occupations. These regulations, which are set out in full on pp. 43–45 of the report, are in startling contrast with the official regulations in force in foreign countries. While foreign Governments have for the most part either made no regulations at all, or have confined themselves to benevolent advice (see report, pp. 46–50), we have in this country adopted, on the initiative of the Home Office, and with the assent of manufacturers, regulations on the points named above, which cannot fail to diminish the more serious evils complained of. Doubtless the pottery manufacturers will be grateful to Profs. Thorpe and Oliver for establishing this point.

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[1] Report to Her Majesty's principal Secretary of State for the Home Department on the employment of Compounds of Lead in the Manufacture of Pottery. By Prof. T. E. Thorpe, LL.D., F.R.S., and Prof. Thomas Oliver, M.D., F.R.C.P.

It was felt, however, that important and valuable as such regulations may be, they leave untouched the kernel of the whole question. The terms of reference contained in the letter from the Home Secretary inviting the co-operation of Prof. Thorpe put the matter very clearly: The Secretary of State desires to ascertain (1) how far the dangers may be diminished or removed by substituting for the carbonate of lead, ordinarily used, either (*a*) one or other less soluble compounds of lead, *e.g.* a silicate; (*b*) "leadless" glaze; (2) how far any substitutes found to be harmless or less dangerous than the carbonate, lend themselves to the varied practical requirements of the manufacturer; (3) what other preventive measures can be adopted.

The report sets forth in a clear, simple, and decided form the conclusions arrived at on these points. It furnishes an account of visits paid to various pottery works on the continent. Results are given of the analytical determination of the proportion of lead compounds in glazes collected from a number of potteries in this country. Valuable tables are also given as to the solubility of various lead compounds, and of certain pottery "fritts" and glazes containing lead, in dilute, hydrochloric, and acetic acids; and, *inter alia*, we find that Prof. Thorpe has discovered in the course of his investigations a compound silicate containing 22 per cent. of lead oxide, which, he says, is insoluble in dilute acids. We are also furnished with the considerations and arguments on which the Professors have based their recommendations.

The recommendations themselves are four in number, and may be summarised as follows:—

(1) The prohibition of lead compounds entirely in the glazes used on seven-tenths of the wares produced in the potteries.

(2) That in all other branches of the pottery industry lead shall only be used in the form of a fritted compound silicate.

(3) That the use of raw lead—*i.e.* white lead—in glazes or colours should be absolutely prohibited.

(4) That the employment of women and young persons as dippers, dippers' assistants, ware cleaners after dippers, and glost placers should be prohibited in all factories where glazes containing lead continue to be used.

That these conclusions, if carried into effect, would do away with lead-poisoning in the pottery industry, there can be no two opinions. That the first and fourth of them, if insisted on in the present state of our knowledge, would cause, not only a serious dislocation of the pottery industry, but the transference of some of it to our foreign rivals (who are, for the most part, under no restrictions whatever as to their use of lead compounds or female labour), there can also be little doubt. Even in view of such circumstances, the adoption of these conclusions might be considered advisable, if an impartial consideration of the facts stated in the report showed that no other conclusions would meet the case. It is necessary, therefore, to consider whether the conclusions arrived at by Profs. Thorpe and Oliver are justified by the information given in the report. It may be said at once that a careful consideration of the report leads one to the conclusion that they are not.

The facts contained in the report may be summed up as follows:—

(1) English potters, generally speaking, use glazes containing "raw," *i.e.* "unfritted" white lead. This compound finds its way into the system, and being readily soluble in the gastric juice produces an excessive amount of lead-poisoning.

(2) Women and young persons are stated to be more susceptible to lead-poisoning in this way than adult males. The figures quoted are open to other interpretations.

(3) Leadless glazes are being tried by several manufacturers in this country on a limited scale. The results obtained so far may be described as satisfactory; but that they have been tried on an adequate scale, and under widely varying conditions, there is not sufficient evidence to prove.

(4) Certain foreign manufacturers, producing pottery similar to that produced in this country, have abandoned the use of "raw" white lead in their glazes.

(5) The glazes stated in the report to be used by these manufacturers contain as large a percentage of lead monoxide as is contained in the glazes used for similar purposes in this country.

(Compare table 1 on page 38 of the report, giving the percentages of lead monoxide found in certain earthenware glazes used in Staffordshire, with the percentages of lead oxide found in the foreign glazes, mentioned on pp. 16–25 of the report.)

(6) The lead compound used in these foreign glazes is either a bisilicate of lead ($PbO2SiO_2$), or a compound silicate containing as bases oxide of lead, alumina, lime, and alkalies (report, pp. 16–25).

(7) Wherever these compounds have been introduced in place of white lead, lead-poisoning has disappeared (report, see pp. 17, 18, 20, 25).

(8) The foreign manufacturers above mentioned use "leadless" glazes no more than English potters do.

(9) Women and young persons are employed at these factories as dippers, dippers' assistants, ware cleaners after dippers or glost placers, and yet there are no cases of lead-poisoning.

The statements thus briefly presented are an accurate summary of the information contained, on these points, in the report, and it is evident that they furnish no warrant for the first and fourth conclusions arrived at by Profs. Thorpe and Oliver. No one doubts that it would make assurance doubly sure to prohibit the use of lead in the glazes used on seven-tenths of the pottery produced in the "potteries" district of Staffordshire. The report contains very little evidence to show that such a cutting of the Gordonian knot is practicable, while it furnishes ample evidence that so drastic a regulation is not required to abolish "plumbism." English potters, from the time of Josiah Wedgwood down to the present, have made numberless experiments to produce leadless glazes. In a paper by Mr. W. P. Rix, published in the *Journal* of the Society of Arts of March 3, 1899, an account is given of the best known of these, and it is shown clearly that in almost every case their use has been abandoned, in some cases after a very lengthy trial, because of practical difficulties connected with their production, which made them too uncertain for general use. The experiments to which Profs. Thorpe and Oliver refer on p. 9 of their report are too recent and too incomplete to afford any justification for the sweeping statement made on that page in the following words, the italics being mine:—

"We have no doubt whatever that leadless glazes, of sufficient brilliancy, *covering power*, and durability, and adapted to all kinds of table, domestic, and sanitary ware, are now within the reach of the manufacturer."

As a matter of fact, it is known to every practical potter who has experimented with leadless glazes, and to none better than those who are working with them at the present time, that leadless glazes of sufficient stability—*i.e.* containing a sufficiently high percentage of alumina to bring them into agreement with the ware—do not become fluid (or "flow," as the potter calls it) in the firing to the same extent that lead glazes do. They are, consequently, deficient in that "covering power," as a potter understands the term, that Profs. Thorpe and Oliver claim for them.

At the general firing temperature of English earthenware glazes, a leadless glaze, even of the very latest type, becomes clear and glossy, but it does not become fluid. It follows from this, that the slightest inequality of thickness produced in the dipping remains after firing; that any small bit knocked or chipped out of the glaze coating before it is fired—an accident of the most ordinary occurrence—leaves a bare spot, for the glaze cannot flow over the space as a lead glaze would; moreover, the mending of imperfectly glazed pieces before firing is rendered almost impossible for the same reason. These points are of the utmost importance in practice, for, while greater care must be taken in sorting the bisque ware before dipping, as well as in the operations of dipping and placing, the proportion of defective pieces may still be too great to be borne. That, at all events, is the past experience of the potters who have worked with leadless glazes; and I feel assured that no firm of pottery manufacturers in this country is prepared to abandon leaded glazes for all their ordinary earthenware at the present time, and face the consequences. I cannot but consider that in this matter Profs. Thorpe and Oliver have been misled by the natural enthusiasm of those who have recently produced leadless glazes, and in their desire to put an end to the evils of lead-poisoning they have over-stated the present value of leadless glazes to the trade at large. The time is not yet ripe for the drastic change proposed in their first recommendation.

Their third conclusion, "that the use of 'raw' lead, *i.e.* 'unfritted' lead, as an ingredient of potters' glazes or colours, should be absolutely prohibited," is not one whit too strong. The experience of pottery manufacturers in this country and on the continent proves that such a course is possible in every section of the trade. Between the bisilicate of lead containing 65 per cent. of lead monoxide, used at Rörstrand (report, p. 20) and at Dresden (report, p. 25), and proved in the experience of those works to have abolished lead-poisoning, and the compound silicate discovered by Prof. Thorpe (see report, p. 32) containing 22 per cent. of lead-oxide, and stated to be insoluble in dilute acids, and therefore non-injurious, there would seem to be ample margin for all the potter's requirements. According to the evidence contained in the report, such compounds have been used for years, or might be used, without producing lead poisoning in those who work with them. Were the use of such of these compounds as are found to best answer the practical requirements of the various trades, made compulsory on every potter in this country, and the Factory Inspectors empowered to take samples from the dipping-tubs for examination in the Government Laboratory, the axe would indeed be laid to the root of this evil.

The report is to be commended to the careful consideration of every one interested in a great industry. The facts stated in it, speaking generally, admit of little or no dispute. From a careful consideration of its pages, one gathers the encouraging conviction that it contains information which will enable the question to be fairly and satisfactorily dealt with from the point of view of workman, manufacturer, and Home Office alike. Its second and third recommendations, worked in conjunction with the monthly medical examination of *all* workers, of whatever sex or age, who come in contact with any form of lead compound, and with the adequate protective provisions as regards ventilation, clothing, and cleanliness, now in force at all pottery works in this country, would put an end, within a reasonable time, to the gross evils of plumbism. It is to be hoped that the pottery manufacturers will rise to the situation, and show their willingness to adopt such of the recommendations contained in the report as are of practical value.[1] The existing state of things, at all events, cannot be allowed to continue.

W. BURTON.

MECHANICAL ENGINEERING IN WARSHIPS.

THE address delivered at the Institution of Mechanical Engineers on Thursday last, by the President, Sir William H. White, K.C.B., F.R.S., was a valuable statement of the part which mechanical engineering has played in the growth of our shipbuilding industry and the development of our mercantile marine during the past forty years. Mechanical engineering has intimate relations with all other branches of engineering, but with none has it been more closely associated than with shipbuilding in recent times; and in his address Sir William White indicated the directions in which the construction and working of ships have been influenced by it. He showed how the development of mechanical appliances for the *equipment and working of ships during the last forty years is* no less remarkable than the advance in the machinery used for shipbuilding. Nearly all steamships are now fitted with mechanical steering gear, mostly steam, in some instances hydraulic, and in a few recent ships electrical. The same motive powers are now used for working anchors and cables in steamships. Artificial ventilation is now very largely employed in many classes of ships, and especially in warships; electric lighting is becoming the rule; mechanical power is universally employed for pumping purposes in steamships; remarkable progress has been made in appliances for lifting coal and cargoes; and refrigerating machinery has led to the development of a new branch of the shipping industry, as well as added to the health and comfort of all who travel by sea. The advances in these and other directions were sketched by Sir William White, but the limitations of space prevent the publication of his address in full. The last section dealt with mechanical engineering in warships, and is here reprinted.

Mechanical Engineering in Warships.

The auxiliary machinery of warships necessarily has much in common with the corresponding machinery in merchant ships. There are, however, many special requirements arising from their armament and equipment as fighting machines, and hence it happens that in warships the applications of mechanical power reach their fullest development. Modern warships are sometimes styled "boxes of machinery," and the description is not inapt. The tendency is, in fact, to multiply machines, and to minimise manual labour to an extent which is not universally approved. On the other hand, with modern armaments and equipment, an extensive use of mechanical power is inevitable, and the expenditure of fuel on auxiliary services grows greater in proportion to that devoted to propulsion.

Ten years ago in a first-class battleship of 12,000 h.p. (maximum) for the propelling machinery, there were fifty auxiliary engines capable of indicating in the aggregate about 5000 h.p. if they all worked simultaneously—which they did not, of course. To-day, a similar statement would show a growth in the auxiliary power as compared with the propelling.

The multiplication of auxiliary services makes very serious demands upon the coal-supply of warships. Even in harbour the expenditure of coal is large on lighting, distilling, ventilation, air-compression, drilling with the heavy guns, and other services. From 10 to 25 tons a day may thus be expended in a large battleship or cruiser of high speed. As warships cruise at low speeds and spend much time in harbour, it results that, taking the year through, fully as much coal is burnt for auxiliary services as for propulsion. Coal endurance being one of the most important factors in warship efficiency, facts such as these have tended to cause a doubt as to the wisdom of more widely extending mechanical appliances. It is pointed out that manual power with simple fittings, such as can be readily replaced if damaged in action, can compete with mechanical appliances in many directions; and that it is better to have larger crews in fighting ships, so as to provide a margin for inevitable casualties, than to use the alternative of labour-saving machines liable to derangement or injury and not easily repaired in action. The practical solution of the problem clearly lies in the due proportion being found between manual and mechanical appliances.

Gun construction in its modern form is largely dependent upon mechanical engineering. Your past-Presidents, Lord Armstrong and the late Sir Joseph Whitworth, were famous as mechanical engineers before they undertook the design and manufacture of guns. In this Address, however, the story of progress from the smooth-bore cast-iron 68-pr., weighing 95 cwts., to the 110-ton breech-loading rifled gun, firing 1800-lb. projectiles, can find no place. Nor can more than a brief glance be taken at the interesting work done by the mechanical engineer in regard to appliances for mounting, working, and loading modern guns, supplying the ammunition, and securing rapidity and accuracy of fire with a minimum of labour.

Anyone who will study the breech mechanism and mounting of a hand-worked quick-firing gun will discover a triumph of mechanical engineering over a very special and difficult problem. Take, for example, a 6-inch quick-firing gun of the latest naval pattern. The gun weighs about 7 tons, fires 100-lb. projectiles, with a muzzle velocity of nearly 2800 feet per second, and an *energy of 5370 foot-tons, corresponding to a penetration of 22* inches of wrought iron. Its breech mechanism is so devised that four or five aimed shots can be fired per minute. Its mounting is so arranged that the gun can be easily trained, elevated or depressed by one man. The great energy of recoil is perfectly controlled, and the crew numbers only four or five men. If such a gun is compared with the 68-pr. smooth-bore muzzle loader, mounted on a wood truck carriage with rude arrangements for elevating, and still ruder for training and controlling recoil, one has a striking illustration of the progress made in forty years with hand-worked guns.

When one passes to heavier guns worked by mechanical power, a still greater contrast appears. The 110-ton gun of 16¼ inches calibre has charges of 960 lbs. of powder and 1800-lb. projectiles. Fired with a velocity of 2100 feet per second, three projectiles have an energy of 54,000 foot-tons with an estimated penetration of 37 inches of wrought iron. Obviously, manual power alone was unequal to working such guns. The mechanical engineer has devised suitable machinery which enables pairs of guns, mounted in a thickly armoured turret, to be

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[1] The pottery manufacturers have already taken action in the direction indicated.